plasma waveguide. There are nine figures and sixteen references, including articles by S. S. Buchsbaum and S. C. Brown, Phys. Rev. 106, 196 (1957), V. Josephson, J. Appl. Phys. 29, 30 (1958); Ginzton, Science, 127, 3308 (1958), and M. Lampert, Phys. Rev. 102, 289 (1956).

S/781/62/000/000/004/036

AUTHOR: Faynberg, Ya. B.

TITLE: Introductory remarks to the theoretical papers on high frequency properties of plasma

PERIODICAL: Fizika plazmy i problemy upravlyayemogo termoyadernogo sinteza; doklady I konferentsii po fizike plazmy i probleme upravlyayemykh termoyadernykh reaktsiy. Fiz.-tech. inst. AN Ukr. SSR. Kiev, Izd-vo AN Ukr. SSR, 1962, 20-27.

TEXT: Four major trends in research on high-frequency properties of plasma are discussed: instability due to interaction between the plasma and a beam, the high frequency properties of plasma, nonlinear effects occurring in the vibrational and wave motions of a plasma, particularly at resonance, and waveguide and oscillating properties of a bounded plasma (plasma waveguides and cavities).

The instability due to the interaction between a beam and a plasma is a decisive factor in many devices (stellarator and others). The earlier theoretical papers were those of Akhiezer and Faynberg and of Bohm and Gross. The results of the earlier paper are compared with

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Introductory remarks to the theoretical . . .

several recent researches by Tuck, Buneman, Auer, Sturrock, and Drummond. Tuck developed an instability mechanism based on the energy lost by the charged particle as it passes through the plasma (dynamic friction). Buneman discussed the case of an electron beam produced by the plasma electrons. Auer derived an instability criterion, in which the motion of the ions is taken into account, and with which the author of the review does not agree. Drummond, applying Sturrock's analysis of convective and absolute instability resulting from the interaction of beams, concludes that in the case of a cold plasma the instability is convective (intensification), but the author claims that investigations he made with his co-workers (reference 1, ZhTF (Journal of Technical Physics) 31, 633, 1961) show that Sturrock's method may prove insufficient in the study of complicated dispersion equations. Recent work on nonlinear analysis of plasma instability and on the behavior of plasma at non-zero temperature is also mentioned, along with various methods of eliminating instability.

The second trend in the research is that dealing with high frequency properties of plasma. Mention is made of the work by K. N. Stepanov on cyclotron resonance in a plasma, where the propagation of electromagnetic waves in unbounded frequency with frequencies close to the electron gyrofrequency or the ion gyrofrequency are investigated. Stepanov and V. I. Pak-

Introductory remarks to the theoretical . . .

homov considered the case when the individual harmonics radiated by the electrons do not overlap as a result of the Doppler effect and derived formulas for the intensity of the cyclotron radiation from a high frequency plasma. V. V. Dolgopolov and K. N. Stepanov calculated the damping of the magnetohydrodynamic waves in a dilute plasma due to "close" collisions between the plasma electrons and ions, and have shown that the dissipation of the magnetohydrodynamic waves may prove to be larger than that given by the two-liquid model of the plasma.

The third trend is the study of nonlinear effects for oscillation and wave motion of plasma, particularly in the case of resonance. Such research is necessary if new methods of thermalization and "phase mixing" are to be developed. A start in this direction was made by V. D. Shapiro, who showed that the use of nonlinear effects near resonance may prove useful. Another possible use of nonlinear effects for the dissipation of energy concentrated in the use of the spectral decay mechanism investigated by Sturrock.

The fourth important trend is the investigation of plasma waveguides and cavities with time-varying geometrical dimensions or parameters, and particularly the effect of collapse of a plasma cavity containing an electromagnetic field. This effect is used in particular (in

Introductory remarks to the theoretical. . .

an investigation made by Faynberg, Lingart, and Kurilko to amplify the high frequency waves reflected from a moving plasma. The use of a moving plasma (pinch or others) to increase the electromagnetic energy needed to contain the plasma is also continuing. The kinetic theory of plasma waveguides and cavities, a study of which was initiated by Sagdeyev and Shafranov, is being extended by Faynberg and Shapiro (Plasma Physics and the Problem of Controllable Thermonuclear fusion, v. 1, Kiev 1962) to include the case of high frequencies.

There are six references, the only one in English being by I Dawson, project Matterhorn, Princeton, 1958.

S/781/62/000/000/005/036

AUTHOR: Faynberg, Ya. B., Nekrasov, F. M., Kurilko, V. I.

TITLE: Contribution to the theory of nonlinear longitudinal waves in a plasma

PERIODICAL: Fizika plazmy i problemy upravlyayemogo termoyadernogo sinteza; doklady I konferentsii po fizike plazmy i probleme upravlyayemykh termoyadernykh reaktsiy. Fiz.-tech. inst. AN Ukr. SSR. Kiev, Izd-vo AN Ukr. SSR, 1962, 27-31.

TEXT: The interaction between a beam of charged particles and a plasma is investigated for a specific distribution function, so as to obtain in closed form expressions for the maximum electric field intensity and for the maximum electric field gradient.

It is shown that the maximum field intensity and gradient depend strongly on the form of the distribution function and on the assumptions made concerning the capture of the particles in the potential well formed by the propagating wave, so that the results obtained are only tentative.

The system of equations describing the interaction between the beam and the plasma has

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Contribution to the theory of nonlinear . . .

the form

$$v\frac{\partial f}{\partial x}+\frac{|e|}{m}\cdot\frac{d\varphi}{dx}\cdot\frac{\partial f}{\partial v}=0, \qquad \frac{d^2\varphi}{dx^2}=4\pi|e|\left\{\int f_{\text{плазмы}}\,dv+\int f_{\text{пучка}}\,dv-n_+\right\}. \tag{1}$$

where n_+ is the density of the ion background (the ions are assumed stationary). The distribution function chosen for the plasma electron is

$$f(v)=\begin{cases} A_{\text{эл}}\exp\left\{-\frac{m}{2T}\left[\left(\frac{2\varepsilon}{m}\right)^{1/2}+V_\phi\right]^2\right\} & (v\geqslant u_0),\\ A_{\text{эл}}\exp\left\{-\frac{m}{2T}\left[\left(\frac{2\varepsilon}{m}\right)^{1/2}-V_\phi\right]^2\right\} & (|v|\leqslant u_0),\\ A_{\text{эл}}\exp\left\{-\frac{m}{2T}\left[\left(\frac{2\varepsilon}{m}\right)^{1/2}-V_\phi\right]^2\right\} & (v\leqslant -u_0), \end{cases} \qquad \frac{mu_0^2}{2}=-|e|\varphi_{\text{мин}}^{\text{пл}}=\frac{mV_\phi^2}{2}, \tag{2}$$

and for the beam electrons $f(v)=A_0\delta(\varepsilon-\varepsilon_0)$.

In the most interesting case, when the phase velocity is very close to the beam velocity,

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Contribution to the theory of nonlinear . . .

the maximum field is given by

$$E^2_{\text{max, max}} = 4\pi m (V_\phi - V_0)^2 \left\{ n_0 - (n_- - n_2) \frac{V_T}{2\sqrt{\pi} V_\phi} \left(1 - \frac{V_0}{V_\phi}\right)^2 \right\}. \quad (5)$$

where V_0 is the beam velocity, and n_- and n_0 are the densities of the uncaptured plasma particles at the point of zero potential and of the beam at this point.

There are six references. The English-language references are by D. Bohm and E. P. Gross, Phys. Rev. 75, 1851 (1949) and by H. K. Sen, Phys. Rev. 97, 849 (1955).

S/781/62/000/000/007/036

AUTHOR: Faynberg, Ya. B., Gorbatenko, M. F., Kuriiko, V. I.

TITLE: Cerenkov radiation in a bounded gyrotropic medium

PERIODICAL: Fizika plazmy i problemy upravlyayemogo termoyadernogo sinteza; doklady I konferentsii po fizike plazmy i probleme upravlyayemykh termoyadernykh reaktsiy. Fiz.-tech. inst. AN Ukr. SSR. Kiev, Izd-vo AN Ukr. SSR, 1962, 34-39.

TEXT: The dispersion properties of a plasma column in a magnetic field differ appreciably from the dispersion properties of an unbounded plasma in a magnetic field, and consequently the interaction between a uniformly moving particle with the fields of a plasma waveguide placed in a magnetic field are of interest. Most previous investigations have dealt with the interaction between a charged particle with electromagnetic waves in unbounded unisotropic and gyrotropic media.

Maxwell's equations in the region occupied by the plasma are solved in straightforward manner, but the expressions are too cumbersome in general, and are interpreted only for

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several limiting cases.

In the case of zero external magnetic field, the retardation due to the Cerenkov effect turns out to be smaller than that due to polarization losses both in the case of small radii and small densities of the plasma.

It can be shown, however, that when the Cerenkov frequency is much smaller than the polarization frequency, a plasmoid may turn out to be coherent with respect to the Cerenkov radiation and incoherent with respect to the polarization losses, and then the Cerenkov losses may prove larger than the polarization losses if the particle density in the plasmoid is high. The author consequently evaluates the losses in each portion of the spectrum separately, regardless of their relative magnitude.

The conditions under which electronic resonance and ion cyclotron resonance are excited are also investigated.

There are eight references, of which only the paper by E. Fermi (Phys. Rev. 57, 485, 1940) is in English.

S/781/62/000/000/013/036

AUTHOR: Faynberg, Ya. B., Shapiro, V. D.

TITLE: Waveguide properties of a plasma cylinder in a longitudinal magnetic field with account of thermal motion in the plasma

PERIODICAL: Fizika plazmy i problemy upravlyayemogo termoyadernogo sinteza; doklady I konferentsii po fizike plazmy i probleme upravlyayemykh termoyadernykh reaktsiy. Fiz.-tech. inst. AN Ukr. SSR. Kiev, Izd-vo AN Ukr. SSR, 1962, 66-70.

TEXT: The article is develoted to a kinetic-approximation investigation of electromagnetic oscillations of a plasma cylinder without account of collisions. This is unlike the previous investigations of the waveguide properties of a plasma cylinder in a magnetic field, which were made for the most part in the hydrodynamic approximation under various assumptions. Certain caution had to be exercised in the treatment of the boundary conditions, which assume very complicated form in the kinetic-theory solution. It was therefore assumed that the dimensions of the surface layer engendered by the thermal motion of the electrons and the ions are small compared with the wavelength. This essentially reduced the problem to a

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Waveguide properties of a plasma cylinder . . .

solution of Maxwell's equations within the volume of the plasma (medium with known dielectric tensor) and in vacuum with boundary conditions that specify a jump in the tangential component of the electromagnetic field in terms of the known jump of the gas-kinetic pressure. The cases in which terms with the gas-kinetic pressure can be of importance in the dispersion equation are then considered.

There are seven references, of which the English-language ones are those by T. Stix (Phys. Rev., 106, 1146, 1957 and Physics of Fluids 1, 308, 1958) and by Chandrasekhar, Kaufman, and Watson (Annals of Physics, USA. 2, 435, 1957).

S/781/62/000/000/014/036

AUTHOR: Faynberg, Ya. B., Khizhnyak, N. A.

TITLE: Space charge waves in modulated beams

PERIODICAL: Fizika plazmy i problemy upravlyayemogo termoyadernogo sinteza; doklady I konferentsii po fizike plazmy i probleme upravlyayemykh termoyadernykh reaktsiy. Fiz.-tech. inst. AN Ukr. SSR. Kiev, Izd-vo AN Ukr. SSR, 1962, 71-72.

TEXT: The one-dimensional problem of modulation of two electron beams with compensated unperturbed space charge is investigated with the aid of the Boltzmann equation and in the approximation of the small-signal theory. The expression derived for the space charge behind modulating grids (V_0—amplitude of the modulating voltage at frequency ω) is

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Space charge waves in modulated beams

$$\rho(x,t)=\frac{te^2V_0e^{i\omega t}}{2\pi i n}\int_{\sigma-i\infty}^{\sigma+i\infty}\frac{\left(\int_{-\infty}^{\infty}\frac{\partial f_0}{\partial\xi}\cdot\frac{\partial\xi}{i\omega+i\beta\xi+\frac{1}{\tau}}\right)e^{\beta x}d\beta}{1+\frac{4\pi e^2}{m\beta}\int_{-\infty}^{\infty}\frac{\partial f_0}{\partial\xi}\cdot\frac{\partial\xi}{i\omega+i\beta\xi+\frac{1}{\tau}}}, \tag{1}$$

and can be simplified if the roots of the denominator in the integrand are known.

The zeros of the denominator are investigated and the conditions under which the roots are complex are determined. It is shown that at specified beam parameters the greatest unstable frequency is determined by the relation

$$\omega_{max}=\frac{(\xi_{10}\Omega_{20}+\xi_{20}\Omega_{10})-3\left(\Omega_{20}\frac{v_{T_1}^2}{\xi_{10}}+\Omega_{10}\frac{v_{T_2}^2}{\xi_{20}}\right)}{(\xi_{10}-\xi_{20})+3\left(\frac{v_{T_1}^2}{\xi_{10}}+\frac{v_{T_2}^2}{\xi_{20}}\right)}, \tag{2}$$

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Space charge waves in modulated beams

where ξ_{10}, ξ_{20}, Ω_{10}, Ω_{20}, v_{T_1}, and v_{T_2} are the unperturbed velocities of translational motion, the plasma frequencies, and the thermal velocities of the first and second beams, respectively. Relation (2) is derived under the condition

$$S_1 = \frac{v_{T_1}^2 \omega^3}{\Omega_{10}^2 \omega_{10}} \ll 1, \quad S_2 = \frac{v_{T_2}^2 \omega^3}{\Omega_{20}^2 \omega_{20}} \ll 1. \tag{3}$$

With increasing parameters S_1 and S_2 in (3), the maximum unstable frequency decreases approximately as $1/v_t$. When $S_1 \gg 1$ and $S_2 \gg 1$, the thermal motion of the beam eliminates the instabilities.

There are no references.

S/781/62/000/000/015/036

AUTHOR: Lyubarskiy, G. Ya., Faynberg, Ya. B.

TITLE: Determination of the partition function of a plasma from the rate of propagation of longitudinal waves

PERIODICAL: Fizika plazmy i problemy upravlyayemogo termoyadernogo sinteza; doklady I konferentsii po fizike plazmy i probleme upravlyayemykh termoyadernykh reaktsiy. Fiz.-tech. inst. AN Ukr. SSR. Kiev, Izd-vo AN Ukr. SSR, 1962, 72-75.

TEXT: It is shown how to calculate the partition function of electrons in a plasma by measuring the phase and group velocities of the longitudinal waves in the plasma. It is assumed that paired collisions can be neglected. The partition function of a plasma determines many of its physical properties, so that any method of determining this function experimentally is of interest.

L. D. Landau has shown that strictly speaking there is no dispersion equation for longitudinal waves, but asymptotically (i.e., for large values of the time), any small perturbation is

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Determination of the partition function of a . . .

a superposition of a series of plane damped waves, and

$$1 + \frac{4\pi e^2}{mk^2} \int \frac{f_0'(u)du}{V_\phi - u} = 0, \qquad (1)$$

where $f_0(u)$ is the equilibrium partition function, can serve as an arbitrary "dispersion" equation. The integration in (1) is along the real axis from $-\infty$ to $+\infty$, with the singularity $V_{ph} = \omega/k$ of the integrand circuited from below.

If electronic longitudinal oscillations of specified frequency are excited in the plasma, a set of damped waves with complex k is produced, but at large distances only one such wave will remain and the others will be damped out. Measurement of the phase velocity of this wave as a function of the frequency yields experimentally the relationship

$$V_\phi = V_\phi(k) \text{ and } k = k(V_\phi). \qquad (2)$$

Once (2) is known, the partition function can be written in the form

Determination of the partition function of a . . .

$$I_\phi(u) = I_\phi(u_0) - \frac{m}{2\pi e^2} \int_{u_0}^{u} \frac{k_\phi(V_\phi)\varepsilon_\phi(V_\phi)}{V_\phi \left(1 - \frac{V_\phi}{V_{gr}(V_\phi)}\right)} dV_\phi \qquad (3)$$

where $k_\phi(V_{ph})$ and $\varepsilon(V_{ph})$ are the real and imaginary parts of the wave vector k corresponding to the real frequency ω, $V_{ph} = \omega/k_\phi$, and $V_{gr} = d\omega/dk_\phi$ is the group velocity.

There are no references.

S/781/62/000/000/027/036

AUTHORS: Faynberg Ya. B., Kurilko, V. I.

TITLE: On adiabatic invariants of a plasma in a magnetic field

SOURCE: Fizika plazmy i problemy upravlyayemogo termoyadernogo sinteza; doklady I konferentsii po fizike plazmy i probleme upravlyayemykh termoyadernykh reaktsiy. Fiz.-tekhn. inst. AN Ukr.SSR., Kiev, Izd-vo AN Ukr. SSR, 1962, 130-132

TEXT: It is demonstrated briefly that an investigation of invariants for a particle moving in a plasma reduces to an investigation of invariants for systems which many degrees of freedom, the theory of which has been developed by Brillouin (ref. 1, The Bohr Atom, 1935) and L. Mandel'shtam (ref. 3, Collected Works, I, 1948). An examination of the behavior of the roots of the dispersion equation shows that the temporal adiabatic invariants for a plasma in a magnetic field do not coincide with the invariants for isolated ions and electrons but tend to them if the plasma density or the wavelength tends to zero. This is also confirmed by physical considerations. A decrease

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in the plasma densiry or in the wavelength corresponds to a decrease in the polarization fields, which are proportional to the charge at half the wavelength, and the presence of which causes a deviation from its natural frequencies from the frequencies of oscillations of isolated ions or electrons. The only other work referred to is H. Alfven's "Cosmical Electrodynamics."

ACCESSION NR: AT4036051 S/2781/63/000/003/0144/0150

AUTHORS: Suprunenko, V. A.; Faynberg, Ya. B.; Tolok, V. T.; Sukhomlin, Ye. A.; Reva, N. I.; Burchenko, P. Ya.; Rudnev, N. I.; Volkov, Ye. D.

TITLE: Coherent interaction of runaway electrons in a pinch

SOURCE: Konferentsiya po fizike plazmy* i problemam upravlyayemogo termoyadernogo sinteza. 3d, Kharkov, 1962. Fizika plazmy* i problemy* upravlyayemogo termoyadernogo sinteza (Plasma physics and problems of controlled thermonuclear synthesis); doklady* konferentsii, no. 3. Kiev, Izd-vo AN UkrSSR, 1963, 144-150

TOPIC TAGS: plasma pinch, plasma radiation, plasma ion oscillation, plasma electron oscillation, plasma compression, discharge plasma

ABSTRACT: The coherent radiation of transverse electromagnetic waves with frequency close to $\omega_0(m_e/m_i)^{1/3}$ (ω_0 -- frequency of longi-

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ACCESSION NR: AT4036051

tudinal oscillations, m_e -- electron mass, M_i -- ion mass) excited in a plasma by a beam of "runaway electrons," was investigated. The experiments were carried out in a straight tube (alundum, 10 cm dia, 25 cm long) usually filled with hydrogen at 1.3 n/m^2, through which a 15 F capacitor bank was discharged from 30--40 kV. Preliminary experiments with the setup were reported elsewhere (ZhTF, v. 30, 1057, 1961). In the present experiment the formation of the current of runaway electrons was investigated along with its correlation with the electromagnetic radiation of the plasma; some characteristics of this radiation were also investigated. The measurements have shown that an electron current, with energy equal to the maximum energy, constituted a small fraction of the total runaway electron current, the bulk of the current being due to electrons with energy somewhat higher than thermal but much lower than maximal. Part of the runaway electron beam goes to the development of electrostatic instabilities in the discharge, which give rise to the occurrence of the electromagnetic radiation. The radiation was found to

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ACCESSION NR: AT4036051

be coherent in the entire range of investigated initial gas pressures, with an intensity which is constant practically along the entire discharge length. The frequency of the electromagnetic radiation was found to be close to the plasma frequency and the power to exceed appreciably the power of thermal radiation from the plasma. The transformation of the longitudinal electrostatic oscillations into transverse electromagnetic waves can be attributed to the nonlinearity of the oscillations in the plasma due to the large amplitude, and also to boundary effects on the surface of the plasma pinch. Orig. art. has: 5 figures and 3 formulas.

ASSOCIATION: None

SUBMITTED: 00	DATE ACQ: 21May64	ENCL: 03
SUB CODE: ME	NR REF SOV: 006	OTHER: 003

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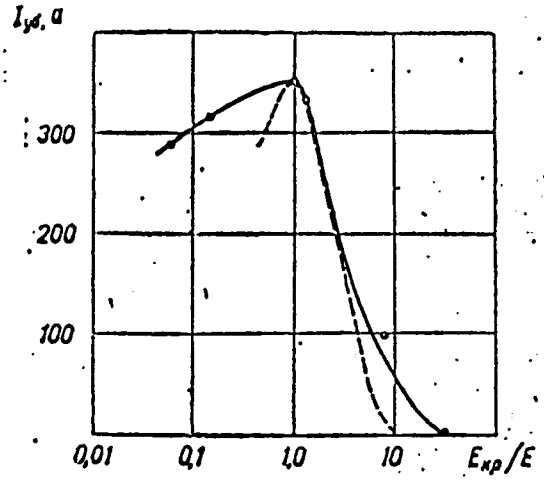
ACCESSION NR: AT4036051

ENCLOSURE: 01



Dependence of runaway electron current on the critical field at constant electric field in a plasma, E = 400 V/m

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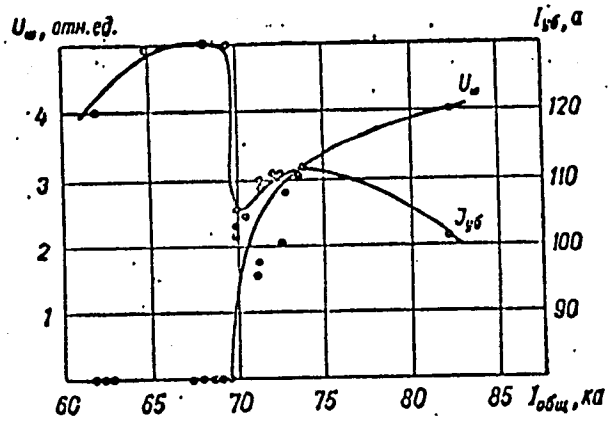
ACCESSION NR: AT4036051

ENCLOSURE: 02

Plasma rad. rel. un.



Runaway elect.

Tot. cur.

Dependence of plasma radiation and of runaway electron current on the total current in the discharge, at hydrogen pressure p = 2.6 n/m² and magnetic field H = 0.6 Tesla

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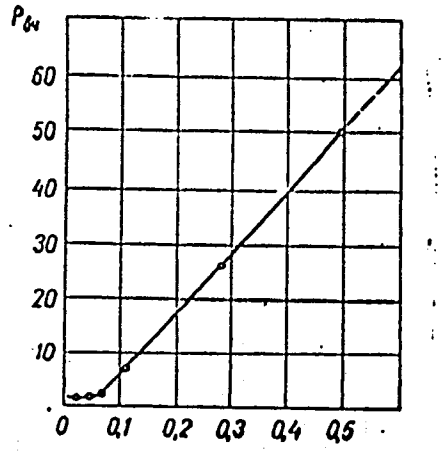
ACCESSION NR: AT4036051

ENCLOSURE: 03



Dependence of hf oscillation power at the receiver on the frequency

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ACCESSION NR: AT4036049 S/2781/63/000/003/0125/0138

AUTHORS: Berezin, A. K.; Berezina, G. P.; Bolotin, L. I.; Lyapkalo, Yu. M.; Faynberg, Ya. B.

TITLE: Interaction of pulsed high-current electron beams with a plasma in a magnetic field

SOURCE: Konferentsiya po fizike plazmy* i problemam upravlyayemogo termoyadernogo sinteza. 3d, Kharkov, 1962. Fizika plazmy* i problemy* upravlyayemogo termoyadernogo sinteza (Plasma physics and problems of controlled thermonuclear synthesis); doklady* konferentsii, no. 3. Kiev, Izd-vo AN UkrSSR, 1963, 125-138

TOPIC TAGS: plasma research, plasma magnetic field interaction, plasma wave absorption, plasma wave reflection, electron beam, microwave plasma, plasma electromagnetic property

ABSTRACT: The investigation reported was aimed at determining the energy losses of a beam passing through a plasma, the conditions

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ACCESSION NR: AT4036049

under which oscillations are excited, the frequency spectrum, the amplification coefficients, the character of instability, and comparison of the experimental data with the theory. The electron beam had an approximate energy 15 keV and a current 5--8.5 A. It was injected in a quartz and glass plasma chamber, ionizing the air in it, producing a plasma, and interacting with the latter. After passing through the plasma the beam was electrostatically analyzed. The procedures used to measure the various parameters are described. The experiments have shown that the beam loses an appreciable part of its initial energy (~18%). This energy is consumed in excitation of oscillations and heating the plasma. Some 50--60% of the energy loss goes to excitation of longitudinal space-charge density waves and transverse electromagnetic oscillations; this agrees qualitatively with the theory. It follows from the measurements that the amplification coefficients and the maximum resonant frequency are also in satisfactory agreement with the calculated data. The longitudinal space charge density waves excited in the plasma and in the beam have

ACCESSION NR: AT4036049

phase velocities which are smaller than the velocity of light in vacuum, and have intensities which reach 50--60 kV/m at the end of the interaction region. A small group of the electrons (1--4% of the total current) experiences an increase in energy up to 50%. If the electron beam is initially modulated, its frequency experiences a Doppler shift at the end of the interaction. Orig. art. has: 7 figures and 5 formulas.

ASSOCIATION: None

SUBMITTED: 00	DATE ACQ: 21May64	ENCL: 02
SUB CODE: ME	NR REF SOV: 016	OTHER: 005

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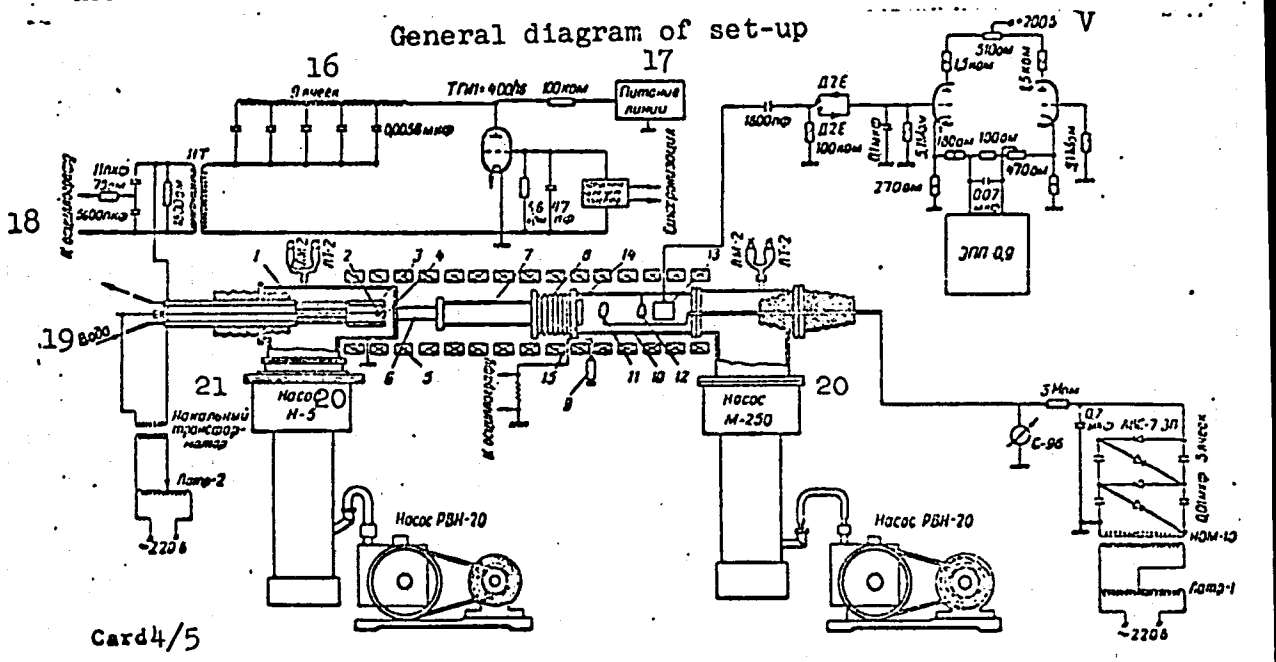
ACCESSION NR: AT4036049

ENCLOSURE: 01

General diagram of set-up



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ACCESSION NR: AT4036049 ENCLOSURE: 02

Legend to Enclosure 01:

1 - electron gun chamber, 2 - cathode heating, 3 -cathode post, 4 - cathode, 5 - solenoid for focusing longitudinal magnetic field, 6 - tube for producing pressure drop, 7 - plasma chamber, 8 - bellows,9 - mechanical leak valve, 10 - 'retarding field' analyzer, 11 - second analyzer grid, 12 - third analyzer grid, 13 - Faraday cup, 14 - entrance flange for measurement of the beam current, 15 - vacuum window for pumping out the plasma chamber, 16 - nine cells, 17 - line supply, 18 - to oscilloscope, 19 - water, 20 - pump, 21 - filament transformer, МКФ - microfarad, КОМ - kilohm, ОМ - ohm,

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ACCESSION NR: AT4036073 S/2781/63/000/003/0300/0318

AUTHOR: Faynberg, Ya. B.

TITLE: Acceleration of charged particles with the aid of light

SOURCE: Konferentsiya po fizike plazmy* i problemam upravlyayemogo termoyadernogo sinteza. 3d, Kharkov, 1962. Fizika plazmy* i problemy* upravlyayemogo termoyadernogo sinteza (Plasma physics and problems of controlled thermonuclear synthesis); doklady* konferentsii, no. 3. Kiev, Izd-vo AN UkrSSR, 1963, 300-318

TOPIC TAGS: charged particle motion, particle acceleration, laser application, wave process, phase velocity, acceleration stability

ABSTRACT: This is a detailed review of the various effects that occur when charged particles interact with light. The feasibility of accelerating charged particles with the aid of intense light beams produced by lasers is analyzed. To this end, the dynamics of par-

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ticles accelerated by forces which are linear in the field intensity are considered, and it is shown that efficient acceleration is hindered by the fact that the ratio of the energy of the particle acquired over a distance on the order of the wavelength to the energy of the particle at rest, which is the governing parameter in the equation of motion of the accelerated particle, decreases by three or four orders of magnitude compared with ordinary accelerators. The conditions for synchronizm between the particle motion and the wave, in order that the particle be continuously in the accelerating-phase region of the high-frequency field, are discussed. It is shown that heavy particles cannot be accelerated by a light wave moving with constant phase velocity at energies less than 10^{14} eV. In the case of electrons, however, the limit drops to 10^{8} eV. Possible ways of maintaining the phase velocity constant with sufficient accuracy are discussed. The radial and phase stability are analyzed and the possibility of attaining simultaneous radial and phase stability considered. It is shown that variable-phase focusing and other types of

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ACCESSION NR: AT4036073

dynamic focusing can ensure radial stability with the aid of high-frequency fields and also simultaneous phase stability, but the maximum attainable accelerated-particle density is much lower than can be obtained by usual phase focusing (10^{13}--10^{15} cm^{-3} for protons). It is shown further that when the accelerated particle moves in a medium simultaneous radial and phase stability with the aid of the accelerating fields only can be attained, and may be the most effective means in the case of acceleration particles with the aid of light. Furthermore, the use of a gaseous medium can resolve the troublesome problem of the slow increase in the phase velocity of the wave along the accelerator, ensure synchronism, and eliminate the effect of the radially defocusing forces. An ionized gaseous medium, in conjunction with suitable choice of parameters, can make such a medium possess waveguide properties. Orig. art. has: 8 formulas.

ASSOCIATION: None

SUBMITTED: 00 DATE ACQ: 21May64 ENCL: 00

SUB CODE: NP, OP NR REF SOV: 007 OTHER: 003

Card 3/3

S/089/63/014/003/002/020
B102/B186

AUTHORS: Berezin, A. K., Berezina, G. P., Bolotin, L. I., Faynberg, Ya. B.

TITLE: Interaction of pulsed high-current beams with a plasma in a magnetic field

PERIODICAL: Atomnaya energiya, v. 14, no. 3, 1963, 249 - 256

TEXT: The passage of pulsed electron beams (pulse duration 3.5 μsec, time between the pulses 50 - 1 sec) of up to 8.5 a and 15 kev through an air plasma of 2.10^{-3} - 2.10^{-5} mm Hg placed in a magnetic field of 360 - 1320 oe was investigated in an arrangement similar to that used previously (Atomnaya energiya, 11, no. 6, 493, 1961). The plasma chamber was 32 cm long and of 40 mm diameter; at a pressure of $4 \cdot 10^{-4}$ mm Hg the plasma density in it was $1.6 \cdot 10^{10}$ cm^{-3} (5 a) and $3.1 \cdot 10^{10}$ cm^{-3} (8.5 a). The longitudinal energy spectrum of the electrons was measured after they had left the plasma in dependence on current (0.5, 5, 8.5 a), on the gas pressure, and on the magnetic field strengths at the entrance and exit of the plasma chamber. The interaction between non-modulated electron bunch and plasma

results in an excitation of high-frequency plasma oscillations which are exponentially amplified along the beam; at the exit, the interaction amounts to 1-2 kv/cm for the longitudinal and 70-100 v/cm for the transverse oscillations. The power losses to the longitudinal waves amount to 6-8 kw per pulse (for 5a, 15 kev, 1320 oe, $6 \cdot 10^{-4}$ mm Hg) : 3 - 4 kw are spent for exciting oscillations in the 825 - 835 Mc band, (half-width 50 - 70 Mc) and 1-2 kw for the 2400 Mc band (half-width 3 - 5 Mc) which is a transverse one. In addition to these bands a noise spectrum arises and at 5 - 8.5 a and $p > 4 \cdot 10^{-4}$ mm Hg the residual gas becomes luminescent. Because of interaction with the plasma the electron energies become scattered over a wide range: They are not only reduced due to energy losses from excitation of electromagnetic and charge-density waves (collisions virtually play no role) but also are increased due to the action of the longitudinal waves. The latter effect is observed down to pressures of $\sim (4 - 6) \cdot 10^{-4}$ mm Hg as long as the collision rate is negligibly small. There are 5 figures and 1 table.

SUBMITTED: May 11, 1962

FAYNBERG, YA.B

AID Nr. 981-5 3 June

COHERENT EM RADIATION FROM A HIGH CURRENT DENSITY PLASMA (USSR)

Suprunenko, V. A., Ya. B. Faynberg, V. T. Tolok, Ye. A. Sukhomlin, N. I. Reva, P. Ya. Burchenko, N. I. Rudnev, and Ye. D. Volkov. Atomnaya energiya, [redacted]14, no. 4, Apr 1963, 349-352. S/089/63/014/004/001/019

Results are given of experiments with plasma discharges at high current densities. Intense radial EM radiation was detected which was coherent and close to Langmuir frequency. Test apparatus included an alundum discharge tube, 10 cm in diameter and 25 cm in length, charged with H_2; aluminum electrodes, connected by a 15-μf capacitor bank charged to 30-40 kv and yielding a discharge current of about 100 kamp; an axial magnetic field variable from 0 to 10 kgs. Efforts to insure repeatability included the use of metal vacuum seals and a titanium pump, the baking of the apparatus at 300°C, and preionization of the gas mixtune prior to discharging. Electric field gradients of 300-500 v/cm gave a high "runaway" electron condition in the discharge beam.

Card 1/2

AID Nr. 981-5 3 June

COHERENT EM RADIATION [Cont'd] S/089/63/014/004/001/019

This current was measured by means of a Faraday cell and a Rogovsky belt, both located at one electrode. A typical test result at a 6-kgs field strength and a 3-4- μsec plasma life showed that coherent EM radiation received by a horn antenna through the tube wall and detected over the 8-14. 4-mm wavelength region was as much as 10^7 times more intense than thermal radiation from a plasma of 10-ev electron temperature, and was constant along the column. Coherence was detected by two probe antennas placed 11 mm apart in the column and connected to an 8-mm interferometer. Variation of the magnetic field from 0 to 8 kgs had no effect on observed radiation. Variation of other parameters revealed a sharply critical value of runaway electron current, below which radiation is absent and above which it rises rapidly in intensity accompanied by a dip in runaway current. This verified a casual relationship between the two. The relation of radiation intensity to initial gas pressures and to radial distance from the plasma column are also discussed. [SH]

Card 2/2

L 8564-65 EWT(1)/EWG(k)/EWA(m)-2/EPA(sp)-2/EPA(w)-2/EEC(t)/T/EEC(b)-2
Pz-6/Pc-4/Pab-24/P1-4 IJP(c)/AFETR/AFWL/SSD/ASD(f)/ASD(a)-5/REAM(a)/
ASD(p)-3/ASD(d)/AEDC(b)/ESD(gs)/ESD(t) AT
ACCESSION NR: AP4040306 S/0057/64/034/006/1031/1036

AUTHOR: Kharchenko,I.F.; Faynberg,Ya.B.; Kornilov,Ye.A.; Pedenko,N.S.

TITLE: Excitation of oscillations in a plasma by an electron beam B

SOURCE: Zhurnal tekhnicheskoy fiziki, v.34, no.6, 1964, 1031-1036

TOPIC TAGS: plasma, plasma density, plasma oscillation generation, plasma magnetic field interaction, electron beam

ABSTRACT: The excitation of oscillations in a plasma in a longitudinal magnetic field by an unmodulated electron beam was investigated experimentally. A 30 cm long beam of 2 to 5 keV electrons was employed with magnetic fields up to 2000 Oe. The plasma was formed by ionization of the residual gas, usually at a pressure of several microns of mercury, first by the electron beam, and subsequently by oscillating plasma electrons. Oscillations of the plasma were observed by examining the signal induced in a dipole antenna located near the apparatus, and by measuring the high frequency component of the electron beam current leaving the system. Intense oscillations were observed at frequencies close to 1.4, 1.65, 2, or 3 times the electron Larmor frequency when the electron beam energy and the magnetic field strength sat-

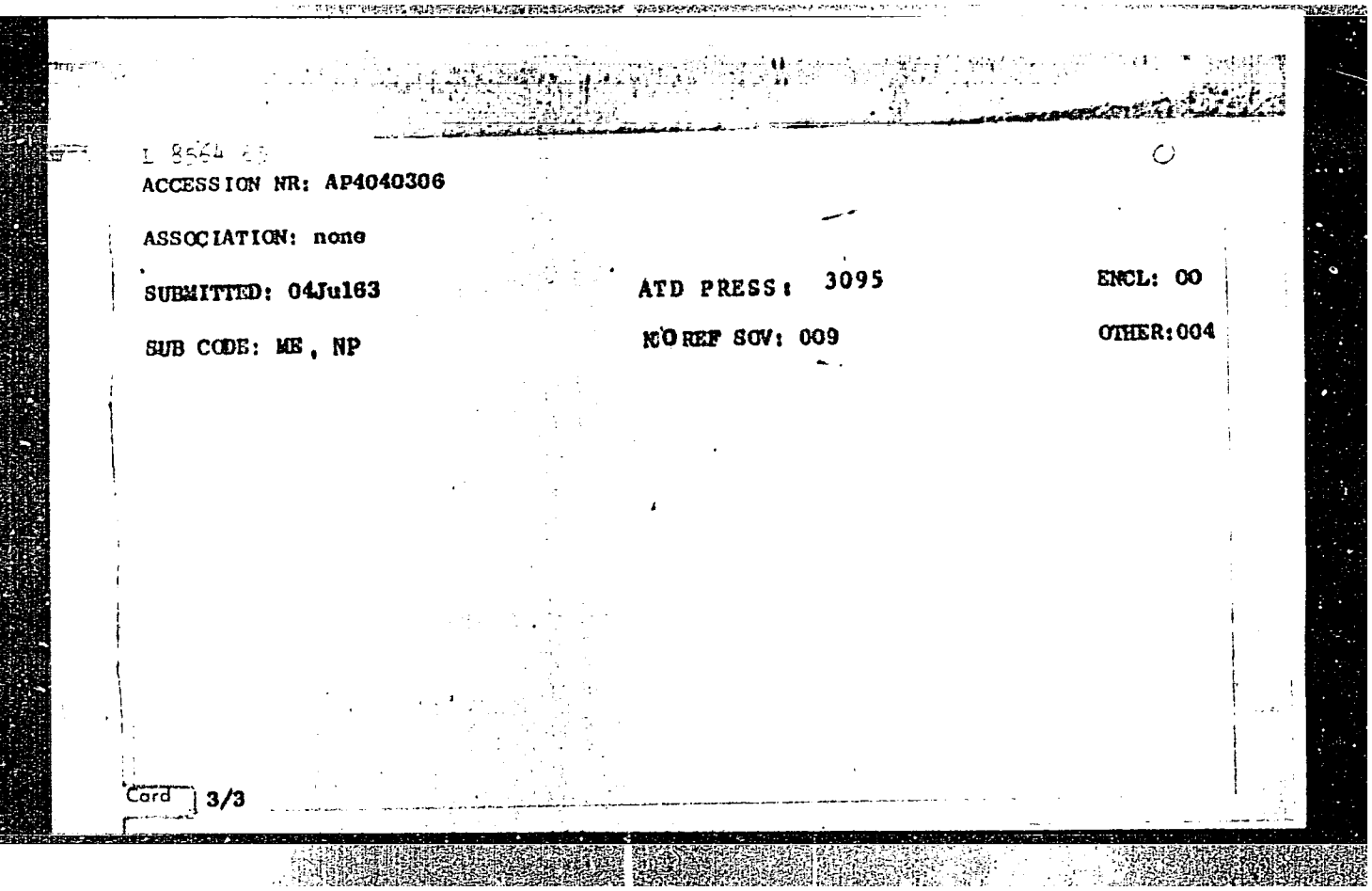
Card 1/3

L 8564-65

ACCESSION NR: AP4040306

isfied certain conditions. When these oscillations were excited the plasma density reached a value between 5×10^{10} and 2×10^{11} cm^{-3}; the oscillation frequency was accordingly approximately equal to the electron Langmuir frequency, and the dispersion was anomalous. The intensity of these oscillations was greatest where the electron beam entered the plasma, and the signal decreased, with a double spatial periodicity, as the dipole antenna was moved along the tube in the direction of the beam. When conditions as regards the beam energy and magnetic field for excitation of these oscillations were not satisfied, oscillations at the Larmor frequency were observed. Low-frequency oscillations (several hundred Mc/sec) were also detected. The oscillations are discussed in terms of the dispersion equation derived by M.F.Gorbatenko (ZhTF 33,173,1963) for the interaction of an electron beam with a plasma. A linear theory, however, cannot account for the discrete regions of magnetic field strength (for fixed electron beam energy) required for excitation of the oscillations, and it is suggested that a non-linear coupling between electron cyclotron oscillations and plasma oscillations is involved. Orig.art.has: 5 formulas and 4 figures.

Card 1 2/3



L 8564 [illegible]

ACCESSION NR: AP4040306

ASSOCIATION: none

SUBMITTED: 04Jul63	ATD PRESS: 3095	ENCL: 00
SUB CODE: ME, NP	NO REF SOV: 009	OTHER:004

Card 3/3

L 13956-65 EWT(1)/EPA(sp)-2/EWG(k)/T/EEC(t)/EPA(w)-2/EEC(b)-2/EWA(m)-2 Po-4/
Pa-6/Pab-10/P1-4 IJP(c)/AFWL/ASD(f)-2/ASD(a)-5/ASD(p)-3/ESD/SSD(b)/SSD/AEDC(b)/
ASD(d)/AFETR/RAEM(a)/ESD(gs)/ESD(t) AT

ACCESSION NR: AP4047907 S/0056/64/047/004/1389/1404

AUTHOR: Faynberg, Ya. B.; Shapiro, V. D.

TITLE: Quasi-linear theory of oscillation excited by an electron beam injected into a plasma halfspace 21 6

SOURCE: Zhurnal eksperimental'noy teoreticheskoy fiziki, v. 47, no. 4, 1964, 1389-1404

TOPIC TAGS: plasma, plasma instability, instability, plasma oscillation, electron beam, beam instability

ABSTRACT: The spatial distribution of the electric fields of oscillations excited by an electron beam injected into a semi-infinite plasma with directed velocity considerably greater than the thermal velocity of plasma electrons is theoretically investigated. In investigating the development of instabilities, particular attention was paid to the nonlinear interaction stage. Two cases were considered: the development of instability during injection of a monoenergetic beam into plasma and during injection of a beam with a

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ACCESSION NR: AP4047907

strongly washed-out velocity distribution function. Since the main aim was the study of the time-dependent formation of transitional layers at the plasma boundaries, only nonstationary and nonhomogeneous solutions of quasi-linear equations were considered. It was shown that two layers with high field intensity, corresponding to the two stages in the formation of instability, are produced during injection of a monoenergetic beam. The energy lost by the beam in excitation of oscillations is stored in the second narrow layer at the plasma boundary in which relaxation of the beam takes place. The oscillation energy density in this layer greatly exceeded the beam energy density. Orig. art. has: 59 formulas and 2 figures.

ASSOCIATION: Fiziko-tekhnicheskiy institut Akademii nauk Ukrainskoy SSR (Physicotechnical Institute, Academy of Sciences, UkrSSR)

SUBMITTED: 21Mar64 ENCL: 00 SUB CODE: NP, ME

NO REF SOV: 011 OTHER: 001 ATD PRESS: 3137

L 04747-67 EWT(1) IJP(c) AT/GD

ACC NR: AT6020454 (N) SOURCE CODE: UR/0000/65/000/000/0229/0234

AUTHOR: Pedenko, N. S.; Bolotin, L. I.; Faynberg, Ya. B.; Kharchenko, I. F.; Shepelev, N. P.

ORG: none

TITLE: High current linear induction accelerator

SOURCE: AN UkrSSR. Vzaimodeystviye puchkov zaryazhennykh chastits s plazmoy (Interaction of charged particle beams with plasma). Kiev, Naukova dumka, 1965, 229-234

TOPIC TAGS: plasma accelerator, plasma heating, betatron accelerator, Mev accelerator

ABSTRACT: A method of generating powerful electron beams and the use of these beams to generate large amplitude electrostatic waves and to heat a plasma are described. The linear betatron constructed for this study consists of an electron source and an accelerating section formed by a power transformer with unity transformation coefficient. The outline of the design is given in a block diagram and its operation is discussed. An electric field of 6 kv/cm was achieved in the accelerating section. The total potential of 200 kv resulted in electron beam currents of 1000 A. The analysis of the design has shown that the most suitable source of energy is a series of capacitors with spark-gap switching. This scheme eliminates synchronization problems and provides a desirable current pulse. The design reported here can basically serve as

Card 1/2

L 04747-67

ACC NR: AT6020454

a guide in the construction of a high current accelerator operating in the megavolt range. Orig. art. has: 2 figures, 1 table, 3 formulas.

SUB CODE: 18 SUBM DATE: 11Nov65/ ORIG REF: 005/ OTH REF: 002

Card 2/2

L 04748-67 EWT(1) LJP(c) AT/GD (N)
ACC NR: AT6020453 SOURCE CODE: UR/0000/65/000/000/0217/0228

AUTHOR: Lutsenko, Ye. I.; Bolotin, L. I.; Faynberg, Ya. B.; Kharchenko, I. F.

ORG: none

53

B+1

TITLE: Investigation of a linear induction accelerator

SOURCE: AN UkrSSR. Vzaimodeystviye puchkov zaryazhennykh chastits s plazmoy (Interaction of charged particle beams with plasma). Kiev, Naukova dumka, 1965, 217-228

TOPIC TAGS: plasma accelerator, plasma pinch, electron polarization, plasma density

ABSTRACT: The aim of the experiments described in the present work was to investigate instability in electron beams generated in a plasma by the application of electric fields greater than those given by the criteria for the "run-away" condition. The accelerating system consists of 12 toroidal cores with one-turn coils. These coils serve as the primary circuit of the accelerating system and are energized by a capacitor discharge. The secondary circuit, formed by a plasma column 4 cm in diameter, was thus subjected to a spiral electric field. The plasma, initially generated by a 0.5 kw HF generator, reached a density of 10^{10} cm^{-3}. The polarization effects, generated current of accelerated particles and the spectrum of the induced oscillations were studied using Rogovskiy coils and microwave equipment. Typical currents of 30 amp with electron energy of 25-30 kev were generated. This is considerably below the available

Card 1/2

L 04748-67

ACC NR: AT6020453

stored energy and is explained by the observed oscillations radiated by the plasma and correlated with the current pulse. Electron beams moving in the opposite direction to the applied field were also observed. These were correlated with the radial pinching of the plasma. Orig. art. has: 7 figures.

SUB CODE: 20/ SUBM DATE: 11Nov65/ ORIG REF: 003/ OTH REF: 006

Card 2/2

L 04751-67 EWT(1) IJP(c) AT/GD

ACC NR: AT6020445 (N) SOURCE CODE: UR/0000/65/000/000/0143/0155

AUTHOR: Faynberg, Ya. B.; Shapiro, V. D.

61
B+1

ORG: none

TITLE: Interaction between a modulated beam and a plasma

SOURCE: AN UkrSSR. Vzaimodeystviye puchkov zaryazhennykh chastits s plazmoy (Interaction of charged particle beams with plasma). Kiev, Naukova dumka, 1965, 143-155

TOPIC TAGS: hydrodynamics, plasma density, plasma beam interaction

ABSTRACT: The beam instability of a modulated beam traversing a plasma in the self-consistent field approximation is investigated. A system of hydrodynamic equations is solved for the electric field, particle velocity and density in terms of one another by assuming the harmonic time dependence for these quantities. The density is assumed to be governed by thermal distribution in the beam, so that the oscillations propagate not only due to the presence of directed energy particles but also because of particles of the plasma. The resulting fourth order equations are split into two sets of second order equations, assuming that the normalized electric field is much less than unity. These equations then completely determine beam density distribution assuming the absence of surface charge on the beam boundary. The solution indicates that electric field change in moving through the modulated beam is given by plasma density

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L 04751-67
ACC NR: AT6020445

alone and not by beam density. Neglecting small terms, the plasma particle velocity change is also obtained. The conditions of instability are restrictive so that the possibility of beam stabilization by resorting to modulation is feasible. Orig. art. has: 37 formulas.

SUB CODE: 20/ SUBM DATE: 11Nov65/ ORIG REF: 006/ OTH REF: 001

Card 2/2 LB

L 25281-65 EWT(l)/EWG(k)/EPA(sp)-2/EPA(w)-2/EEC(t)/T/EWA(m)-2 Po-4/Pi-4/Pz-6/
Pab-10 IJP(c) AT

ACCESSION NR: AP5003997 S/0089/65/018/001/0005/0014

AUTHOR: Berezin, A. K.; Faynberg, Ya. B.; Bolotin, L. I.; Berezina, G. P.

TITLE: High-frequency oscillations resulting from the interaction of an electron beam with plasma

SOURCE: Atomnaya energiya, v. 18, no. 1, 1965, 5-14

TOPIC TAGS: electron beam oscillation, plasma oscillation, electron plasma interaction, plasma convective instability, plasma longitudinal wave

ABSTRACT: Experiments were performed on the detection and investigation of the oscillations generated in the beam and plasma as a result of their interaction. The experiments were carried out under the condition that the electron Langmuir plasma frequency ω_0 was smaller than the electron cyclotron frequency ω_H. Measurements were made of the frequencies of the waves generated in the beam, their phase velocities, the amplification factors, the intensity of the electric field, the absolute values, and the spectral distribution of the oscillation power. The measurements were conducted for standing and traveling waves at currents of 5 and 8.5 amp in a longitudinal magnetic field of from 720 to 1320 gauss. The frequency of maximum amplified oscillations for 5 amp current was $f_1 \approx 0.53 f_0$, where $f_0 = \omega_0/2\pi$,

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L 25281-65

ACCESSION NR: AP5003997

which coincides with calculated data. For a current of 8.5 amp $f_1 \approx 0.44 f_0$. The experimental values for the amplification factors were from 0.21 to 0.26 cm^{-1}, which [illegible] to the calculated 0.32 cm^{-1}. Graphs show that a convective instability [illegible] during the interaction between the electron beam and the plasma. The [illegible] as generated within the frequency range from 300 to 1100 Mc sec are longitudinal waves in the beam and plasma brought about by the Cerenkov-Gavrilov effect. [illegible] art. has: 9 figures and 4 formulas.

ASSOCIATION: none

ENCL: 00

SUB CODE: NP, AE

Card 2/2

L 45594-65 EPF(n)-2/EPA(w)-2/EWT(1)/EWG(m) Pi-4/Po-4/Pz-6/Pab-10 IJP(c)

S/0089/65/018/003/0271/0273

AP5009120

[illegible] Reynberg, Ya.B.; Bolotin, I.I. Berezina, L.F.

[illegible] elimination of the total energy lost by an electron beam interacting with the plasma 21

SOURCE: Atommaya energiya, v. 18, no. 3, 1965, 271-273

TOPIC TAGS: plasma beam interaction, plasma magnetic field interaction, power loss, calorimeter

[illegible] work supplements earlier experiments (Atomnaya energiya [illegible] Fizika plazmy i problemy [illegible] Plasma Physics and Problems [illegible], No. 111, Kiev, [illegible], [illegible] [illegible] of the longitudinal component [illegible] of energy of [illegible] beam with energy 15 keV interacting with plasma [illegible] magnetic field. The earlier experiments analyzed [illegible] part of the beam (1--3% of the total current through the plasma) [illegible] in the present experiments the total beam was analyzed using a high-sensitivity calorimeter. The equipment is similar to that used in

Card 1/2

L 45592-65

ACCESSION NR: AP5009120

... work. The new calorimeter is described in detail. It ... measure the average power of the electron beam ... chamber, as a function of ... density, and the ...

... with the calorimeter was ... determined ... to heat a specified current of water through the ... with the average power ...

frequency. The results agreed within ... figure, 2 formulas, 3 tables.

...: None

... 04Jun64 ENCL: 00 SUB CODE: NS

... 003 OTHER: 001

Card 2/2

EWP(m)-2/EPA(w)-2/EWT(1)/EWG(m) Pc-4/Pr-4/Pab-4 IJP(c)

ACCESSION NR: AP5012464 UR/0089/65/018/004/0315/0322

Berezin, A. K.; Berezina, G. P.; Bolotin, [illegible] Lyapin, O. Yu. M.; Pavlenko, Ya. B.

TITLE: Interaction of modulated heavy-current [illegible] electronic beams with a plasma in a longitudinal magnetic field

SOURCE: Atomnaya energiya, v. 18, no. 4, 1965, 315-322

TOPIC TAGS: plasma beam interaction, longitudinal magnetic field, beam modulation

The authors report the results of experimental investigations of the [illegible] modulated [illegible] current pulse electron beams with a plasma situ- [illegible] udinal magnetic field. The experimental [illegible] enclosure. The plasma [illegible] frequency [illegible] oscillations excited by the [illegible] between [illegible] and modulated as well as unmodulated electron beams [illegible] [illegible] The results show that under certain conditions the modu- [illegible] interacts with the plasma more strongly than [illegible] modulated one, and longitudinal waves with considerably larger electric field intensity by a factor

Card 1/2

L [illegible]-65

ACCESSION NR: AP5012464

of approximately 7) than the beam without initial modulation are [illegible] excited [illegible] beam and in the plasma. The distribution of the longitudinal component of the high-frequency field in the plasma along the system axis was investigated [illegible] of the set-up shown in Fig. 2 of [illegible]. Measurements [illegible] to calculate the spatial [illegible] of [illegible] current and for different powers of [illegible]. [illegible] initial modulation of 600 watts, the increments were found to be [illegible], .09, and 0.06 cm^{-1}, respectively. The energy loss due to the initial modulation, amounting to about 7 ± 3% of the initial energy of the beam, is in agreement with earlier measurements. Orig. art. has: 7 figures, 4 formulas, and 1 table.

ASSOCIATION: none

SUBMITTED: 01Jul64	ENCL: 02	SUB CODE: ME	
NO REF SOV: 013	OTHER: 001	ATD PRESS: 4008	

Card 2/4

L 5260-66 EWT(l)/ETC/EPF(n)-2/EWG(m)/EPA(w)-2 IJP(c) AT

ACC NR: AP5026437 SOURCE CODE: UR/0089/65/019/004/0336/0342

AUTHOR: Faynberg, Ya. B.; Shapiro, V. D.

ORG: none

TITLE: Interaction between a modulated beam and a plasma

SOURCE: Atomnaya energiya, v. 19, no. 4, 1965, 336-342

TOPIC TAGS: plasma beam interaction, electron beam, plasma instability, beam modulation

ABSTRACT: A self-consistent analysis is presented of the parametric and two-stream instabilities that can develop in a system comprising a plasma and a modulated electron beam in the form of a periodic sequence of compensated bunches moving through the plasma at constant velocity. The oscillations produced in the system are determined by linearizing the standard set of single-component hydrodynamic equations, which then yield expressions for the perturbations of the plasma-particle density and velocity as well as the electric-field perturbations. The results confirm a hypothesis advanced by one of the authors (Faynberg, Atomnaya energiya v. 11, 313, 1961), that modulation of the electron beam appreciably changes the frequency spectrum and the growth increments of the oscillations excited in the plasma, and also the effective temperatures of the beam and of the plasma, in such a way that certain instability components are suppressed. At the same time, the instability components having the same wavelengths and frequencies as the beam modulation, increase in intensity. "The

Card 1/2 UDC: 533.9

L 5260-66
ACC NR: AP5026437

3

authors thank V. I. Kurilko for a discussion of the results." Orig. art. has: 33 formulas. [02]

SUB CODE: ME,NP/SUBM DATE: 28Dec64/ ORIG REF: 007/ OTH REF: 001/ ATD PRESS: 4138

Card 2/2

L 49252-65 EWT(m)/EPA(w)-2/EWA(m)-2 Pab-10/Pt-7 IJP(c)

ACCESSION NR: AP5010801 UR/0057/65/035/004/0635/0642

AUTHOR: Lutsenko, Ye.I.; Bolotin,L.I.; Faynberg,Ya.B.; Kharchenko,I.F.

TITLE: Investigation of a linear induction accelerator

SOURCE: Zhurnal tekhnicheskoy fiziki, vo. 35, no. 4, 1965, 635-642

TOPIC TAGS: linear accelerator, electron acceleration, plasma, betatron, plasma instability, plasma polarization, plasma heating

ABSTRACT: The authors have investigated the bahavior of the "linear plasma [illegible] proposed earlier by one of them (Ya.B.Faynberg, Atomnaya energiya, 11, 4, [illegible]). The apparatus consisted of a 100 cm long 4 cm diameter glass discharge [illegible] wound for 50 cm of its length by 12 toroidal iron cores each bearing a [illegible] copper turn. Plasma was produced in the discharge tube by high frequency discharges between electrodes at the ends, and a 25 kV 0.6 μfd capacitor was discharged through the copper turns. The "run away" electrons accelerated by the induced electric field were the principal object of study. The mean energy of the "run away" electrons was found to be considerably less than should be expected from the strength of the accelerating field. Plasma polarization and instability effects

Card 1/2

L 49252-65

ACCESSION NR: AP5010801

were brought to account for this reduced electron energy, and both were found. The [illegible]ization was detected by observing with an oscilloscope the signal from [illegible]des near the ends of the discharge tube and development of plasma [illegible] was followed by measuring the radiation from the oscillating plasma in [illegible] microwave region. Under some conditions accelerated electrons were observed [illegible]ing in the backward direction. It is suggested that these may result from a [illegible] but further experiments will be required for their elucidation. "In [illegible], the authors express their gratitude to N.A.Khizhnyak for discussing the results of the work." Orig. art. has: 2 formulas and 6 figures.

ASSOCIATION: None

SUBMITTED: 26Jun64 ENCL: 00 SUB CODE: NP, ME

NR REF SOV: 004 OTHER: 004

Card 2/2

L 2488-66 EWT(1)/ETC/EPF(n)-2/EWG(m)/EPA(w)-2 IJP(c) AT
ACCESSION NR: AP5020720 UR/0057/65/035/008/1372/1377

AUTHOR: Kornilov, Ye. A.; Kovpik, O.F.; Faynberg, Ya. B.; Karchenko, I.F.

TITLE: Mechanism of plasma formation during development of beam instability

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 35, no. 8, 1965, 1372-1377

TOPIC TAGS: plasma instability, plasma heating, plasma beam interaction, plasma oscillation, electron beam, magnetic field, air, hydrogen, argon

ABSTRACT: The authors have investigated the production of plasma by a 3-5 mm diameter 10-50 mA beam of 2-5 keV electrons traversing the 40 cm length of a 10 cm diameter glass tube containing air, argon, or hydrogen at different pressures in the presence of a 0-2 kOe longitudinal magnetic field. The plasma density was determined with Langmuir probes, with a 10 kMc/sec interferometer, and by the detuning of a 3 kMc/sec resonant cavity. Oscillations excited in the plasma were received with a dipole antenna outside the chamber and were investigated with a spectral analyzer and with resonance wavemeters. At pressures below a critical value the plasma density was close to the beam density and oscillations near the Larmor frequency were observed. When the pressure was increased through the criti-

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L 2488-66
ACCESSION NR: AP5020720

cal value the plasma density increased by two or three orders of magnitude (ionizations of 10% were achieved in argon) and oscillations were observed near the Langmuir frequency, which at the plasma densities reached was higher than the Larmor frequency. The plasma density pulsated over a range of 50% at a frequency between 10 and 100 kc/sec. In the region of instability (which is ascribed to the Cerenkov effect), the electron beam lost nearly all its energy to the plasma. The authors believe that their results together with those of L.D.Smullin and W.D. Getty (Phys. Rev. Letters, 9, 1, 3, 1962; J. Appl. Phys., 34, No. 12, 1963) indicate that with a beam of higher power there can be obtained highly ionized hot plasmas, heated by the kinetic energy of the beam. Orig. art. has: 8 figures.

ASSOCIATION: none

SUBMITTED: 26Oct64 ENCL: 00 SUB CODE: ME

NR REF SOV: 004 OTHER: 005

Card 2/2

L 2489-66 EWT(l)/ETC/EPF(n)-2/EWG(m)/EPA(w)-2 IJP(c) AT
ACCESSION NR: AP5020721 UR/0057/65/035/008/1378/1384

AUTHOR: Kornilov, Ye. A.; Kovpik, O. F.; Faynberg, Ya. B.; Bolotin, L. I.; Kharchenko, I. F.

TITLE: Time variations of high frequency oscillations during development of instability in a beam-plasma system

SOURCE: Zhurnal tekhnicheskoy fiziki, v. 35, no. 8, 1965, 1378-1384

TOPIC TAGS: plasma instability, plasma beam interaction, plasma oscillation, electron beam, magnetic field

ABSTRACT: The authors have continued their investigations, described in the preceding paper (ZhTF, 35, 1372, 1965; see abstract AP 5020720), of the production of plasma by an electron beam traversing a gas in a longitudinal magnetic field. The authors describe their apparatus in the preceding paper and in more detail elsewhere (Fizika plasmy i problemy upravlyeyemogo termoyadernogo sinteza, Vol.4. Izd. AN USSR, Kiyev, 1964). It was found that oscillations are excited at integral multiples of half the Larmor frequency and that the width and peak frequency of the spectrum of these oscillations vary periodically at the frequency of ionic sound.

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L 2489-66 0
ACCESSION NR: AP5020721

The spectrum narrows with increasing pressure and broadens with increasing beam current. When the magnetic field strength is increased beyond a certain value, the oscillations cease to be continuous but come in bursts which follow each other at intervals that decrease with increasing magnetic field strength. Tilting the beam moderately with respect to the direction of the magnetic field so as to introduce a small transverse velocity component increased the amplitude of the oscillations by two orders of magnitude. The reasons for the pulsation of the oscillations at high field strengths, for the increase of the amplitude of the oscillations in the presence of a transverse electron velocity component, and for the periodic variation of the spectrum of the oscillations are still obscure. Orig. art. has: 7 figures.

ASSOCIATION: none

SUBMITTED: 26Oct64 ENCL: 00 SUB CODE: ME

NR REF SOV: 012 OTHER: 007

Card 2/2

L 00346-66 EWT(1)/EPF(n)-2/EWG(m)/EPA(w)-2 IJP(c) AT

ACCESSION NR: AP5019249 UR/0056/65/049/001/0329/0334

AUTHOR: Bass, F. G.; Faynberg, Ya. B.; Shapiro, V. D. 44,55 56 B

TITLE: Quasilinear theory of a weakly turbulent plasma with account of correlation of the electric fields 21,44,55

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki, v. 49, no. 1, 1965, 329-334

TOPIC TAGS: turbulent plasma, plasma beam interaction, plasma electron oscillation, plasma electron temperature, plasma stability

ABSTRACT: Inasmuch as the existing quasilinear theory is based on the premise that the correlation time is infinite, the authors derive the equations for a turbulent plasma with account of the influence of the finite time of correlation of the electric microfields. This approach is shown to be valid for a plasma placed in an external electric field whose phase and amplitude vary at random. The model assumed for the plasma is that proposed by T. H. Stix (MATT-239, Preprint, 1964), wherein the plasma consists of alternating regions in each of which the phase is fixed, but the phase changes from region to region are random. The particular case considered is that of a circularly polarized electromagnetic wave propagating in the direction

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ACCESSION NR: AP5019249

of the external magnetic field. The nonlinearity of the plasma oscillations is taken into account only by introducing the correlator of the amplitudes of the Fourier components of the electric fields; other effects connected with the nonlinearity of the oscillations are disregarded. It follows from an analysis of the kinetic and Maxwell's equations that energy can be transferred in such a system to nonresonant plasma particles, and that if the correlation time is finite it is possible for the plasma electrons to become heated by the transverse component of the electromagnetic field. The stabilizing effect of such an energy transfer is discussed briefly. Orig. art. has: 24 formulas.

ASSOCIATION: None

SUBMITTED: 25Feb65 ENCL: 00 SUB CODE: ME

NO REF SOV: 003 OTHER: 001

Card 2/2

10

L 4242-66 EWT(1)/EWT(m)/ETC/EPF(n)-2/EWG(m)/EPA(w)-2/EWA(m)-2 LJP(c)
ACCESSION NR: AT5007973 OS/AT/JXT S/0000/64/000/000/1023/1028 106 103 EM1

AUTHOR: Berezin, A. K.; Berezina, G. P.; Bolotin, L. I.; Gorbatenko, M. F.; Yegorov, A. M.; Zagorodnov, O. G.; Kornilov, B. A.; Kurilko, V. I.; Lutsenko, Ye. I.; Laypkalo, Yu. M.; Pedenko, N. S.; Kharchenko, I. F.; Shapiro, V. D.; Shevchenko, V. I.; Faynberg, Ya. B.

TITLE: Acceleration of charged particles with the aid of longitudinal waves in plasma and plasma waveguides

SOURCE: International Conference on High Energy Accelerators. Dubna, 1963. Trudy. Moscow, Atomizdat, 1964, 1023-1028

TOPIC TAGS: high energy accelerator, electron beam, plasma accelerator, plasma waveguide

ABSTRACT: Plasma waveguides and noncompensated electron and ion beams can be utilized as accelerating systems in linear accelerators (Faynberg, Ya. B., Symposium CERN 1, 84 1956); *Atomnaya energiya* 6, 431 (1959)). In such systems, slow electromagnetic waves $v_\phi \leq c$ are propagated, which are necessary for particle acceleration. The waveguide properties of restrained plasma and noncompensated beams are displayed in the case of waves in the meter and centimeter range even for com-

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ACCESSION NR: AT5007973

paratively small plasma densities around 10^9 to 10^{13} cm^{-3}). Under these conditions the high-frequency energy losses during wave propagation, which are due to the collisions of plasma particles, are small. The density of electrons in metals (about 10^{23}) is many orders greater than is necessary for ensuring waveguide properties in the microwave range. This leads to great losses of high-frequency power during wave propagation in metallic conductors. For plasma densities around 10^9 to 10^{13} cm^{-3}, the energy losses during particle transist through the plasma, which are proportional to plasma density, are insignificant, from 10^{-5} to 10^{-6} ev/cm. This means that plasma waveguides are "transparent" for accelerated particles. According to the conditions of acceleration the particles are divided into individual bunches. Thus the loss of particles moving in the plasma can increase greatly because of the occurrence of coherent deceleration representing the inverse of the effect of coherent acceleration, which was established by V. I. Veksler (Symposium CERN 1, 80 (1956)). However, even for accelerated particle fluxes of the order of tens of amperes, these losses are all insignificant. Because waveguide properties are determined by the plasma, the metal surfaces can be remote from regions with large field strengths or eliminated altogether, which permits a significant increase in the permissible voltages of the accelerating fields and a substantial de-

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crease in the high-frequency energy losses. It is also important to concentrate the electromagnetic energy in the radial direction only in the regions where the accelerated particles are moving. Thus for a given field strength the electromagnetic energy flux decreases markedly. If the fluxes of accelerated particles are large, the waveguide properties necessary for acceleration can be ensured by the particles of the beam which are not entrapped in the acceleration process, through which particles the entrapped particles move. The beam itself which is injected into the accelerator operates under these conditions of an accelerating system. To clarify the possibilities of particle acceleration by means of electromagnetic waves excited by charged particle beams, and also to investigate the influence of beam instabilities upon the acceleration process, the Physicotechnical Institute, Academy of Sciences Ukrainian SSR conducted theoretical and experimental investigations on the interaction of charged particle beams with a plasma. These investigations were intended to lead to, not the design and construction of a definite accelerator model, but the physical processes occurring during the interaction under consideration, and in this way to a determination of the possibilities of plasma methods of acceleration which are being developed at this institute. The theory developed up to the present time of the interaction between beams and plasma has been essentially a linear theory. As a result of the work of V. D. Shapiro and V.

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ACCESSION NR: AT5007973

I. Shevchenko at this institute for the case of beams of not very large density, a nonlinear theory has been created which permits one to trace the process of interaction of an initially nonmodulated beam and mono-energetic beam with a plasma from the initial stage to saturation. As is shown, a large part of the beam's energy of ordered motion (75% of its initial energy) is lost by the beam as a result of collective interactions with the plasma. Thus the energy expended upon excitation of oscillations amounts to 30%; upon increasing the thermal energy of the plasma, to 30%; and upon increasing the thermal energy of beam, to 15%. The experimental investigations of this interaction were carried out by I. F. Kharchenko and A. K. Berezin and their respective co-workers. Their results are in agreement with the theory of M. F. Gorbatenko. The mentioned institute has also carried out further theoretical and experimental investigations on the problems of electromagnetic wave propagation in plasma waveguides excited by high-frequency wall sources. The experimental studies, by O. G. Zagorodnov, et al., showed that the results agree well with theory under conditions of insignificant nonlinear effects. Current experiments are concerned with highly-ionized plasmas with density 10^{11} to 10^{12}. Orig. art. has: 4 figures, 1 table.

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L 4242-66

ACCESSION NR: AT4007973

ASSOCIATION: Fiziko-tekhnicheskiy institut AN UkrSSR (Physicotechnical Institute, AN UkrSSR)

SUBMITTED: 26May64 ENCL: 00 SUB CODE: NP

NO REF SOV: 005 OTHER: 001

Card 5/5

L 06313-67 EWT(l) IJP(c) AT/GD

ACC NR: AT6020431 (N) SOURCE CODE: UR/0000/65/000/000/0007/0023

AUTHOR: Berezin, A. K.; Faynberg, Ya. B.; Bolotin, I. I.; Berezina, G. P.

50
B+1

ORG: none

TITLE: High frequency oscillations excited during electron beam interaction with plasma

SOURCE: AN UkrSSR. Vzaimodeystviye puchkov zaryazhennykh chastits s plazmoy (Interaction of charged particle beams with plasma). Kiev, Naukova dumka, 1965, 7-23

TOPIC TAGS: HF oscillator, plasma heating, electron beam, cyclotron frequency

ABSTRACT: The generation of oscillations in a plasma and the electron beam traversing the plasma and the study of the resulting waves are described. The experiments were conducted with the plasma frequency smaller than that of the electron cyclotron frequency. A beam current of 8.5 and 5 A and a magnetic field in the range of 720-1320 oe (parallel to current) were used. The frequencies generated in the experiment were determined by magnetic probes and wavemeters. All three spatial components were determined. The frequency spectrum of 400 to 3200 cps was measured. These measurements show that the intensity of the generated waves in the beam depend on the ambient pressure. At higher pressure values, a characteristic plateau was found. The wave intensity was also found to increase in the beam direction, and to decrease as the magnetic field decreased. These results are discussed and compared with the theoretical predic-

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L 06313-67

ACC NR: AT6020431

tions. The agreement is shown to be good. Under the conditions of the experiment some 18% of the beam energy was lost to the plasma through the excited oscillations in the plasma as well as through the heating of the plasma. At most, 60% of the lost energy was found in the plasma oscillations. Orig. art. has: 10 figures, 4 formulas.

SUB CODE: 20/ SUBM DATE: 11Nov65/ ORIG REF: 009/ OTH REF: 001

Card 2/2 gd

L 00312-67 EWA(1) IJP(c) AT/GD

ACC NR: AT6020432 SOURCE CODE: UR/0000/65/000/000/0024/0035

AUTHOR: Kornilov, Ye. A.; Kovpik, O. F.; Faynberg, Ya. B.; Khrachenko, I. F.

12
B+1

ORG: none

TITLE: Investigation of particle energy and conditions of excitation of low frequency oscillations in a plasma formed by the growth of instabilities in a beam-plasma system

SOURCE: AN UkrSSR. Vzaimodeystviye puchkov zaryazhennykh chastits s plazmoy (Interaction of charged particle beams with plasma). Kiev, Naukova dumka, 1965, 24-35

TOPIC TAGS: ion current, ion density, plasma interaction, plasma beam interaction, acoustic frequency

ABSTRACT: The conditions necessary for the excitation of ion currents in experiments where electron beams traverse the plasma are reported. The experiment is described and a diagram of it is given. An electron beam of 2-5 kev electrons (10-80 mA) is incident on the plasma in the magnetic field (0-2 kg) parallel to the beam. Movable analyzers were used thus permitting the interaction length of beam and plasma to be changed. Analysis of the discharge showed that ion current density across the magnetic field lines is smaller than that along the field lines. These currents could be generated only when the ambient pressure was between $4 \cdot 10^{-4}$ and 10^{-2} mm Hg. The current maximum also appears at a pressure corresponding to maximum plasma oscillations. It is also shown

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ACC NR: AT6020432

that the electron ion currents emerging from the plasma are equal to the current entering the plasma. The observation of outflowing currents has shown that for sufficiently long plasma-beam interaction length, the current from the end of the plasma consisted solely of ions. The investigation of the frequency distribution of the excited oscillations shows that the ion current arises in situations favoring the production of instabilities. The most favorable conditions for generating beams of ions with energies up to 1 kev are given. The study of excitation frequency change with electron temperature and type of gas used shows that the low frequency oscillations generated in the experiment were near the ion-acoustic frequencies. Further study of the generation of low frequencies is needed. Orig. art. has: 6 figures, 1 table.

SUB CODE: 20/ SUBM DATE: 11Nov65/ ORIG REF: 017/ OTH REF: 003

Card 2/2

L 06311-67 EWP(c) AT/GD

ACC NR: AT6020433 (N) SOURCE CODE: UR/0000/65/000/000/0036/0043

AUTHOR: Kornilov, Ye. A.; Kovpik, O. F.; Faynberg, Ya. B.; Bolotin, L. I.; Kharchenko, I. F.

48
B+1

ORG: none

TITLE: Time characteristics of high frequency oscillations during the development of instabilities in the plasma-beam system

SOURCE: AN UkrSSR. Vzaimodeystviye puchkov zaryazhennykh chastits s plazmoy (Interaction of charged particle beams with plasma). Kiev, Naukova dumka, 1965, 36-43

TOPIC TAGS: HF oscillator, plasma beam interaction, plasma electron density, critical magnetic field

ABSTRACT: Spectral characteristics and time variations of oscillations excited in a plasma by a traversing electron beam are studied. A 4 mm diameter beam (80 mA) was injected into a plasma in a magnetic field (0-2 koe). Beam energy varied from 2 to 5 kev. The beam-plasma interaction region was 40 cm long and the plasma electron density was 10^{12} cm^{-3}. Variations in the parameters of the experiment led to the conclusion that when conditions favorable to beam instability growth (a brief discussion of these is given based on the literature cited in the bibliography) are established, the excitations occur which have maxima at frequencies corresponding to half-integral multi-

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L 06311-67

ACC NR: AT6020433

ples of electron cyclotron frequencies. The spectrum near the maxima changes periodically during the discharge; the time period of the change is very close to that of the ion-acoustic wave. It is shown that relative width of the spectrum narrows as the pressure increases and broadens with increase of the beam current. At magnetic field intensities higher than critical, the plasma-beam discharge was found to change to a relaxation type of wave excitation. During the excitation periods, the beam current was strongly damped indicating very strong interaction with the plasma. Orig. art. has: 5 figures.

SUB CODE: 20/ SUBM DATE: 11Nov65/ ORIG REF: 012/ OTH REF: 007

Card 2/2

L 08810-67 EWT(1) IJP(c) AT/GD (N) SOURCE CODE: UR/0000/65/000/000/0069/0092

ACC NR: AT6020438

AUTHOR: Faynberg, Ya. B.; Shapiro, V. D. 52

ORG: none

TITLE: Quasilinear theory of excitation of oscillations during the injection of an electron beam into a semi-infinite plasma

SOURCE: AN UkrSSR. Vzaimodeystviye puchkov zaryazhennykh chastits s plazmoy (Interaction of charged particle beams with plasma). Kiev, Naukova dumka, 1965, 69-92

TOPIC TAGS: electron beam, plasma beam interaction, plasma oscillation

ABSTRACT: The aim of the present work is to explain the spatial dependence of electric fields occurring in a plasma upon which the electron beam is incident. The spatial anisotropy arises due to the finite extent of plasma and the beam, features not considered in theoretical problems of this sort. Here a semi-infinite plasma is considered and the region near the boundary is studied for the case of a beam with an electron velocity much greater than the group velocity of plasma oscillations. Vlasov's equation for collisionless parameters is written to describe noise fields. It is examined in the linear approximation and applied in the derivation of the spatial dependence of the fields. It is shown that the total energy density of the excited oscillations can greatly exceed the directed kinetic energy of the beam, indicating ag-

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L 08810-67

ACC NR: AT6020438

gregation of energy near the plasma boundary. As the field intensity in this region is increased, relaxation occurs more rapidly and the boundary layer becomes narrower. A uniform beam is also considered; it is shown to generate a double boundary layer, when sufficient time has elasped. The dimensions of such a layer are computed and it is shown that the second peak is the more intense. Orig. art. has: 68 formulas.

SUB CODE: 20/ SUBM DATE: 11Nov65/ ORIG REF: 011/ OTH REF: 002

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L 08809-67 EWT(1) IJP(c) AT/GD (N) SOURCE CODE: UR/0000/65/000/000/0092/0103

ACC NR: AT6020439

66

AUTHOR: Faynberg, Ya. B.; Shapiro, V. D.

ORG: none

TITLE: On the nonlinear theory of the interaction of a relativistic beam and a plasma

SOURCE: AN UkrSSR. Vzaimodeystviye puchkov zaryazhennykh chastits s plazmoy (Interaction of charged particle beams with plasma). Kiev, Naukova dumka, 1965, 92-103

TOPIC TAGS: plasma beam interaction, plasma instability, strong magnetic field, kinetic equation, electron beam

ABSTRACT: The dynamics of the development of instability appearing during the interaction of a relativistic uniform beam of electrons with a plasma is investigated from the initial phase through the saturating phase and the formation of a stationary spectrum of oscillations. It is assumed that the plasma is in strong magnetic field parallel to the beam direction and that the beam density is much smaller than the plasma density. The excited waves are considered to be one-dimensional and moving parallel to the beam. The kinetic equation and field equations are analyzed for several degrees of nonlinearity. It is shown that beam acceleration occurs at the expense of increasing the thermal spread of the beam and the kinetic and potential energy of the induced oscillations. For larger values of beam velocities, the instability leads to a second

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L 08809-67

ACC NR: AT6020439

quasilinear phase. At lower values, the beam remains uniform. The analysis also brings out the existence of a strong oscillating additive term in such beam characteristics as density and momentum. Orig. art. has: 31 formulas.

SUB CODE: 20/ SUBM DATE: 11Nov65/ ORIG REF: 006/ OTH REF: 002

Card 2/2 nst

L 24119-66 EWT(1)
ACC NR: AP6014609 SOURCE CODE: UR/0386/66/003/009/0354/0357

AUTHOR: Kornilov, Ye. A.; Faynberg, Ya. B.; Bolotin, L. I.; Kovpik, O. F. 72 B

ORG: Physicotechnical Institute, Academy of Sciences, Ukrainian SSR (Fiziko-tekhnicheskiy institut Akademii nauk Ukrainskoy SSR)

TITLE: Suppression of low-frequency oscillations in two-stream instability by prior modulation of the electron beam

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 3, no. 9, 1966, 354-357

TOPIC TAGS: plasma instability, plasma oscillation, plasma beam interaction, electron beam, beam modulation

ABSTRACT: This is a continuation of earlier work (coll. Vzaimodeystviye puchkov zaryazhennykh chastits s plazmoy [Interaction of Charged Particle Beams with a Plasma], p. 18, Kiev, 1965), where it was shown that development of a two-stream instability is accompanied, besides high-frequency oscillations (1000--6000 Mcs), also by low-frequency oscillations (10 kcs--30 Mcs) and by intense ion currents. To check on the cause of these low-frequency oscillations and to find methods of suppressing these oscillations, the authors experimented with an electron beam (up (2/

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to 100 ma) of 2--5 kev particles injected into an interaction chamber situated in a longitudinal magnetic field of intensity up to 2000 oe. The experimental setup was similar to that described earlier. The results show that the low-frequency oscillations are caused by the high-frequency ones and can be suppressed by modulating the beam at a modulating frequency equal to twice the electron gyro frequency. The prior modulation of the beam suppresses also the high-frequency oscillations. The suppression efficacy increases with increasing depth of modulation. Orig. art. has: 2 figures.

SUB CODE: 20/ SUBM DATE: 28Feb66/ ORIG REF: 005

L 36246-66 EWT(1) I/P(c) AT

ACC NR: AP6023638 SOURCE CODE: UR/0386/66/004/001/0032/0036

AUTHOR: Faynberg, Ya. B.; Shapiro, V. D.

ORG: Physicotechnical Institute, Academy of Sciences, Ukrainian SSR (Fiziko-tekhnicheskiy institut Akademii nauk Ukrainskoy SSR)

TITLE: Stabilization of low-frequency plasma instabilities

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 4, no. 1, 1966, 32-36

TOPIC TAGS: plasma instability, plasma electromagnetics, plasma charged particle, dispersion equation

ABSTRACT: The authors consider theoretically the feasibility of stabilizing drift instability of an inhomogeneous plasma by superimposing an external high-frequency electric field parallel to the magnetic field. The change in the drift-wave frequency due to the external field is calculated and is found to increase. The increase in frequency increases in turn the magnitude of the stabilizing term in the expression for the drift-wave growth increment. The range in which this stabilization is effected is determined. From the results of the calculation and also from solution of the dispersion equation for a collisionless drift instability in a high-frequency field it is learned that the width of the interval in which high-frequency stabilization takes place is maximal when the ion Larmor radius tends to zero. With increasing Larmor radius this width decreases and tends to zero for infinite radius. A high-frequency

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L 36246-66

ACC NR: AP6023638

electric field can also stabilize drift instability of a plasma with frequent collisions (drift-dissipative instability), but this calls for larger amplitudes than in the case of a collisionless drift instability. The authors thank B. B. Kadomtsev and A. B. Mikhaylovskiy for a discussion of the results and V. I. Shevchenko for help with the work. Orig. art. has: 8 formulas.

SUB CODE: 20/ SUBM DATE: 08May66/ ORIG REF: 009

Card 2/2

L 44714-66 EWT(1) IJP(c) AT SOURCE CODE: UR/0386/66/004/004/0147/0152

ACC NR: AP6031588

AUTHOR: Kornilov, Ye. A.; Faynberg, Ya. B.; Kovpik, O. F.

ORG: Physicotechnical Institute, Academy of Sciences, Ukrainian SSR (Fiziko-tekhnicheskiy institut Akademii nauk Ukrainskoy SSR)

TITLE: Spatial and temporal correlations of electric fields in a weakly turbulent plasma

SOURCE: Zhurnal eksperimental'noy i teoreticheskoy fiziki. Pis'ma v redaktsiyu. Prilozheniye, v. 4, no. 4, 1966, 147-152

TOPIC TAGS: turbulent plasma, plasma diagnostics, electric field, autocorrelation function, spectral energy distribution, plasma beam interaction, plasma instability

ABSTRACT: The purpose of the present work was to determine the spectral energy density E_k^2 of the electric field during the transition of a plasma into a turbulent state, using as an example the simplest and most prevalent two-stream instability. This was done by measuring the spatial autocorreleation functions of the electric fields of high-frequency oscillations excited in a plasma-beam discharge. The experiment was carried out with an electron beam with energy up to 5 kev and current 20-100 ma, in a magnetic field up to 2000 G and at 10^{-4} mm Hg pressure (Fig. 1). Under these conditions, a plasma was produced with density up to 6×10^{11} el/cm^2. With the aid of a cylindrical cavity placed ahead of the interaction chamber, the beam could be modulated at a frequency of 3,000 MHz. The spatial autocorrelation function F(l) was

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ACC NR: AP6031588

determined by summing oscillations (600-6000 MHz) received at different points of the discharge in a quadratic detector, with subsequent time averaging. From the form of the autocorrelation function it was possible to estimate the correlation length and the spectral energy density of the electric field. Plots are presented of the spatial autocorrelation functions of the oscillations and spectral energy density of the electric field and of the temporal autocorrelation functions of the oscillations. It is deduced from an analysis of the results that the oscillations of a plasma-beam discharge have an irregular stochastic character, with the correlation length and the correlation time depending essentially on the oscillation amplitude. A decrease in the oscillation amplitude, as well as external modulation, leads to an increase in the length and time of the correlation and to a transition from irregular to regular oscillations. The authors thank V. D. Shapiro and V. I. Kurilko for a discussion of the results, A. G. Shevlyakov for help with the measurements, and L. I. Bolotin for interest and help with the work. Orig. art. has: 3 figures and 3 formulas.

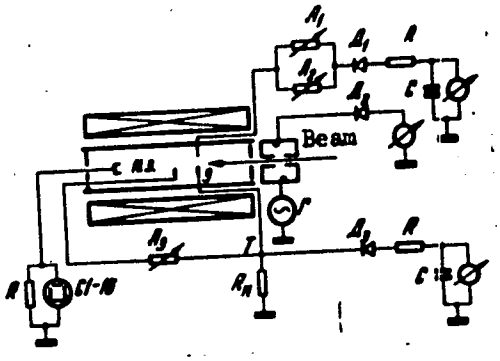

Fig. 1. Measurement scheme

SUB CODE: 20/ SUBM DATE: 11Jun66/ ORIG REF: 008/ OTH REF: 001

KNSHISHYAN, T.N.; VARSHAL, B.G.; FAYNBERG, Ye.A.

Changes in the crystallization properties of aluminum - magnesium glass as dependent on the CaO:MgO:Al_2O_3 ratio. Trudy MKHTI no.24: 237-246 '57. (MIRA 11:6)

(Glass research) (Vitreous state)

FAYNBERG Ye. A.

AUTHORS: Kitaygorodskiy, I. I., Keshishyan, T. N., 72-58-3-1/15
Faynberg, Ye. A.

TITLE: Investigation of the Types of Glass in the System SiO_2-$-Al_2O_3$-B_2O_3-BaO (Issledovaniye stekol v sisteme SiO_2-Al_2O_3-$-B_2O_3$-BaO)

PERIODICAL: Steklo i Keramika, 1958, /5 Nr 3, pp. 1-5 (USSR)

ABSTRACT: This system has not yet been thoroughly investigated. A series of synthetically produced glass-compositions in this system, the major part of which refers to the field of heavy barium-chromates with a high barium-oxide content (45 to 55%), is shown in technical literature. Vargin and Kefeli investigated the reaction of silicate-formation in the layer of heavy barium chromate C-24. Data on the measurements of viscosity of these types of glass, as well as a description of their melting under operating-conditions are equally available. A series of works is devoted to an increase in the chemical stability of the heavy barium chromates. 6 types of glass which were synthetically manufactured in this

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Investigation of the Types of Glass in the System SiO_2-Al_2O_3-B_2O_3-BaO

system, are given in the work by Navias and Grin (table 1). In view of determining the ranges of glass-formation in this system, the authors selected 3 variants with a constant Al_2O_3- content of 10, 20 and 30%, in which case the compositions of glass are given in molecular per cent. The quantity of SiO_2 was changed from 20 to 70%, that of B_2O_3 from 10 to 60%. The glass-compositions are seen in table 2. Moreover, the composition of the layers and the melting are fully described. All types of glass were melted simultaneously in a furnace with oil-heating, according to a severe regime of temperature, as given in the table, in which case crucibles of corundum - from the Khar'kov-works for refractory products - were used. The control was effected by means of a binocular microscope MBS-1. The viscosity of the glass types was measured according to the method by Inglish and its values within the temperature-range of from 550 to 800°C are given in table 3. The dependence of the temperature on the chemical composition of certain types of glass is shown in figures 1 and 2. The linear coefficient of expansion was measured by means of the quartz-dilatometer VNIIS and the results are given in table 4. The dependence

Investigation of the Types of Glass in the System SiO_2-Al_2O_3-B_2O_3-BaO

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of the coefficient of expansion on certain glass-compositions is seen from figures 3, 4 and 5, whereas the diagram of equal coefficients of expansion is given in figure 6. The electrophysical properties of the various alkalifree types of glass were also investigated from which it may be concluded that these types of glass should be of great interest for the electro-vacuum-industry. The same types may also be recommended as insulators of high quality on account of their high electric resistance. Furthermore, the various figures are explained in detail. Conclusions:

1) The range of glass-formation in the section of the system up to 30 molecular% Al_2O_3 was investigated and compositions were discovered which form glass at 1450° and 1550°C.
2) The inclination of the types of glass for crystallisation was investigated and the constant compositions determined.
3) The problem of the state of boranhydride in the investigated types of glass was dealt with.
4) The found values of the investigated types of glass allow to recommend their use in some fields of electro-vacuum--engineering. There are 6 figures, 3 tables.

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Investigation of the Types of Glass in the System SiO_2-Al_2O_3-B_2O_3-BaO

72-58-3-1/15

ASSOCIATION: MKhTI imeni D. I. Mendeleyeva (MKhTI imeni D. I. Mendeleyev)

1. Metal oxides--Silicon dioxide systems--Chemical analysis
2. Glass--Analysis

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SOV/72-59-3-4/19

15(2)
AUTHORS: Kitaygorodskiy, I. I., Bayburt, L. G., Zertsalova, I. N., Karpechenko, V. G., Faynberg, Ye. A.

TITLE: Investigation of the Possibility of Obtaining the "Vizhurit" Glass (Issledovaniye vozmozhnosti polucheniya stekla vizhurit)

PERIODICAL: Steklo i keramika, 1959, Nr 3, pp 12 - 13 (USSR)

ABSTRACT: The shatterproof glass presently manufactured has the defect of completely disintegrating into fragments, although not dangerous ones, when given a blow. It is however required in motor car traffic that on destruction of the glass at least a small part of it, the one in front of the driver's eyes, is left undamaged. In 1956 the authors of the present paper carried out investigations at the Gusevskiy zavod imeni Dzerzhinskogo (Gusev Factory imeni Dzerzhinskiy) for the purpose of obtaining a "Vizhurit" type glass, which is produced abroad by various patented processes. Experiments were made on the flat windshields of the "Moskvich" car (974 x 327 x 5.5 mm). The results obtained are shown in figures 1 and 2, but they are not regarded as satisfactory,

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as the glass, according to figure 2 burst after 10 - 15 days as a consequence of internal strains. These experiments must now be carried on. There are 2 figures.

ASSOCIATION: Gusevskiy zavod imeni Dzerzhinskogo (Gusevskiy Factory imeni Dzerzhinskiy)

FAYNBERG, YE. A.

15(2) SOV/72-59-5-1/23

AUTHOR: None Given

TITLE: Glass Science at the VIII Mendeleyev Congress (Nauka o stekle na VIII Mendeleyevskom s"yezde)

PERIODICAL: Steklo i keramika, 1959, Nr 5, pp 1-4 (USSR)

ABSTRACT: In the beginning a proclamation of the TsK KPSS to the personnel of the building material industries for a qualitative and quantitative increase of production is mentioned. The Congress took place in Moscow in the second half of March of the current year and was devoted to the 125th anniversary of the great scholar's birthday. Outstanding chemists of the Soviet Union and the People's Democracies attended the Congress. The principal problems of the development of chemistry were discussed at the plenary meetings and the meetings of the 18 Congress sections. Professor I. I. Kitaygorodskiy opened the meetings of the sub-section for glass and gave a survey of the stages of development of Soviet glass production as well as of a number of promising tasks in the field of glass technology. Moreover, the following lectures were held: Doctor Korani (People's Republic of Hungary) investigated the structure of the top-layers of glass;

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A. I. Avgustinnik (LTI imeni Lensovet) discussed the formation of a finely disperse crystalline phase from the glass-like phase; V. V. Vargin and G. O. Karapetyan (GOI) reported on absorption spectra, luminiscence, and photochemical properties of cerium-glass types; A. G. Vlasov (GOI) reported on the quantitative reciprocal relations between ordered and dis-ordered glass phases; Ye. A. Poray-Koshits, Institut khimii silikatov AN SSSR (Institute of Silicate Chemistry of the AN USSR) discussed the reasons for the disagreement on the problem of the structure of glass-like substances; Professor O. K. Botvinkin, N. I. Ananich, and M. L. Mironova, Institut stekla (Glass Institute) reported on the Investigation of the Glass Structure by the Method of Thermal Analysis and Optical Polarization; Ye. V. Podushko (GOI) discussed the new method of electric glass melting and the melting of silicates by means of high-frequency current; Yu. G. Shteynberg reported on strontium-magnesium glazes without lead and boron for faience and majolica which have been developed in the Gosudarstvennyy nauchno-issledovatel'skiy keramicheskiy institut (State Scientific Research Institute of Ceramics); L. N. Yastrebova, and V. S. Molchanov (GOI) discussed the role played by the

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surface protection film in the destruction of silicate glasses; G. I. Veynberg (GOI) discussed the coloring characteristics and the technology of phosphate glasses; O. V. Mazurin (LTI) reported on the mobility of sodium ions in glass types of the system Na_2O-RO-SiO_2; Z. A. Nosova (NII Stroykeramika) discussed the process of subduing the glazes by lead oxide and zirconium; L. G. Mal'tichenko, Khar'kovskiy politekhnicheskiy institut (Khar'kov Polytechnic Institute) reported on silicate formation and sintering processes in the briquetted glass layer; K. M. Yevstrop'yev investigated various types of glass; N. N. Semenov (Glass Institute) reported on the determination of impurities in silica by spectroscopic analysis; G. N. Bogdanova, and Ye. N. Orlova (Glass Institute) reported on types of electrode glass which has been devised by them. Yu. V. Rogozhin (Glass Institute) discussed the kinetics of the formation of crystallization centers in photo-sensitive types of glass; Z. M. Syritskaya (Glass Institute) discussed the results of the investigation of the tendency of phosphatic systems towards glass formation; L. A. Grechanik, N. L. Pairovykh, and V. G. Karpechenko (NIIES) reported on the investigation of types of semiconducting oxide glass on the basis of V_2O_5; N. V. Solomin, L. A. [illegible], T. V. Mavakova, and Ye. A. Faynberg (NIIES) discussed the production of conductive films on types of glass which contain components easily to be regenerated.

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B101/B102

AUTHORS: Grechanik, L. A., Faynberg, Ye. A., and Zertsalova, I. N.

TITLE: Electrical conductivity of sodium-lead-silicate glasses containing iron oxide

PERIODICAL: Fizika tverdogo tela, v. 4, no. 2, 1962, 454 - 457

TEXT: The coexistence of ionic conductivity and n-type conductivity was studied from the effect of Fe_2O_3 and NaO on the electrical resistance of glass specimens containing 60 mole% SiO_2 and 40 mole% PbO, in which PbO was replaced by Fe_2O_3 (1 - 10%) and Na_2O (2 - 15%). The process of glass melting and the method used to measure the resistance will be described later. Addition of Fe_2O_3 to the lead-silicate glass lowered the resistance substantially (Fig. 4). Sodium-oxide glasses possess ionic conductivity, and iron-oxide glasses have n-type conductivity, whereas glasses containing Na_2O and Fe_2O_3 exhibit both types, the total conductivity is, however,

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Electrical conductivity of...

lower. $\log\varrho = f(E)$ is a linear function for either type. The activation energy E (ev) was calculated from $\varrho = \varrho_0 \exp(E/2kT)$. With $Na_2O + Fe_2O_3$ glasses, the points lay between the two straight lines for ionic conductivity and n-type conductivity. The activation energy of glasses with ionic conductivity and with the same volume resistivity as that of n-type glasses is higher than that of the latter type. n-type conductivity occurred already at 2 - 3% Fe_2O_3. This effect of low Fe_2O_3 concentrations requires special investigations. A paper of O. V. Mazurin et al. (ZhTF, 27, 2702, 1957) is referred to. There are 6 figures, 1 table, and 6 references: 4 Soviet and 2 non-Soviet. The reference to the English-language publication reads as follows: S. Strauss, D. Moore, W. Harrison, L. Richards, J. Res. Nat. Bur. Stand., 56, 135, 1956.

ASSOCIATION: Nauchno-issledovatel'skiy institut elektrotekhnicheskogo stekla, Moskva (Scientific Research Institute of Electrotechnical Glass, Moscow)

SUBMITTED: September 11, 1961

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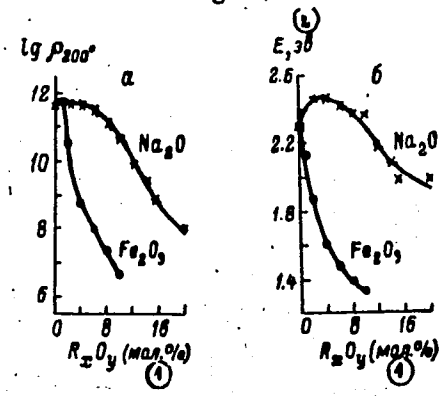
Electrical conductivity of...

Fig. 4. Effect of replacement of PbO in lead-silicate glass by Na_2O and Fe_2O_3 on electrical resistance (a) and activation energy (б).

Legend: (1) mole%; (2) ev.

Fig. 4



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GRECHANIK, L.A.; FAYNBERG, Ye.A.; ZERTSALOVA, I.N.

Conductance of sodium-lead-silicate glass containing iron oxide. Fiz.tver.tela 4 no.2:454-457 F '62. (MIRA 15:2)

1. Nauchno-issledovatel'skiy institut elektrotekhnicheskogo stekla, Moskva.

(Glass--Electric properties)

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15.2100

AUTHORS: Kitaygorodskiy, I. I., Doctor of Technical Sciences, Professor, Faynberg, Ye. A., Engineer, Grechanik, L. A., Candidate of Technical Sciences

TITLE: Effect of some oxides on the reduction of lead glasses

PERIODICAL: Steklo i keramika, no.12, 1962, 8 - 10

TEXT: Three problems gave rise to the present paper: (a) Semiconducting layers forming on glass surfaces by reduction; (b) the problem of eliminating the discoloration of glasses on thermal treatment in a reducing atmosphere; (c) effect of the chemical structure of glasses on the diffusion of reducing gases. Binary P-40 (R-40) lead glasses consisting of 60% SiO_2 and 40% PbO were used. At a constant content of PbO, 5 or 10% SiO_2 was replaced by Na_2O, BaO, ZnO, CdO, B_2O_3, Al_2O_3, TiO_2, V_2O_6, Cr_2O_3, MnO_2, Fe_2O_3, CoO, or NiO at 1250 - 1300°C (30 - 40 min), then the glass was reduced for 4 hrs in a hydrogen atmosphere at 400°C. The transparency T_λ was measured spectrophotometrically in the 350 - 1100 mμ

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region. The integral transparency S was determined from the curve T_λ versus λ and the change was calculated to be $T_{red} = \sqrt{S_1/S_o}$, where S_1 is the integral transparency of reduced, and S_o of non-reduced glasses. Furthermore, glasses in which Li_2O, Na_2O, K_2O, Rb_2O, or Cs_2O, were substituted for 15% SiO_2, were reduced for 3 hrs in H_2 at 360°C, and the transparency was also measured. Results: Glasses containing 5 and 10% Cr_2O_3 and 10% NiO crystallized; the transparency of specimens containing 10% CoO was too low. The other specimens showed the possibility of classifying oxides under the experimental conditions: (1) Oxides that support the Pb reduction: V_2O_5, NiO, Al_2O_3, and to a smaller extent also Na_2O; (2) oxides by which the reduction is not affected: TiO_2, CoO, B_2O_3, and CdO; (3) oxides inhibiting the reduction of Pb: $Fe_2O_3 > MnO_2 > ZnO > BaO$. Hence it is concluded that new electrochemical glasses, very stable to thermal treatment in a reducing atmosphere, can be produced from lead glasses containing Fe_2O_3 or MnO_2. The increase in reducibility of lead